REMARKS

Applicant has addressed every ground for rejection in the Office Action dated September 15, 2009, and believes the application is now in condition for allowance. Accordingly, reconsideration of this application is respectfully requested. Additionally,

I. The claims are not obvious over *Bowman.*

Claims 17, 19-21, 24, 25 and 28 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Bowman (5,160,696). In particular, the Examiner argues that claim 17 is obvious in view of *Bowman*, claiming that it would have been obvious to a skilled person to use Pb-Bi in the molten salt recirculation loop 94 of Figure 4. For the reasons set forth below, among others, it is respectfully submitted that the claims are novel and non-obvious and should be allowed.

In *Bowman*, in column 11, lines 37 to 41, it is stated that the molten salt mixture of the recirculation loop may contain a ^7LiF (Lithium Fluoride)/BeF_2 (Beryllium Fluoride) mixture, or a UF_4 (uranium tetrafluoride)/^7LiF (Lithium Fluoride) mixture. The requirements of the molten salt mixture are highlighted in col. 11, lines 38-41 (*"for the transport of dissolved fluorine salts of the actinides or of fission products into and out of the recirculation loop"*) and further in col. 11, lines 48-51. (*"high thermal to electric conversion efficiency ... .owing to the high operating temperature of the molten salt mixture"*). It is also stated in col. 11, lines 43-45, that an ion/fluoride balance should be maintained in the circulation loop.

A Pb-Bi material would not provide the required functions in particular for the transport of dissolved fluorine salts, and thus would not work nor satisfy the requirements of the system of *Bowman*.

Moreover, in the present application (page 80, lines 27-30), it is clearly stated that no appreciable heat is produced in the transmutation process of the present application.

Instead, Lead and Bismuth exhibit characteristics which enable the technical effects of the present invention to be achieved by elastic scattering and the resultant progressive decrease in energy. Both Lead and Bismuth have a small neutron capture

cross section compared to their neutron elastic scattering cross section. In the case of Lead, the neutron scattering cross section is approximately 11 barns while the neutron absorption cross section is 0.0048 barns. In the case of Bismuth, the neutron scattering cross section is approximately 9 barns while the neutron absorption cross section is 0.034 barns. This enables a high proportion of elastic scattering.

Both Lead and Bismuth, or a mixture thereof, have a very small lethargy (fractional average energy loss at each neutron elastic collision) to the order of 9.54 10-3 (see page 3, line 30 to page 4, line 7 of the present application).

The effect of the above features of lead/bismuth is a progressive decrease in energy of the neutrons. In such a medium, the neutron energy is slightly reduced at each elastic scattering event and thus scanning, in very tiny energy steps through the resonance spectrum matching the largest value of the capture cross section of the relevant isotope of the sample, can be achieved. The progressive decrease in neutron energy thereby leads to enhanced neutron capture because of the resonance spectrum matching and thus the portion of radioisotope transmuted is maximized. This, in turn, enables the required amount of radioisotope to be produced with a relatively modest neutron generator.

In contrast, the molten salt region of *Bowman* does not exhibit these properties which lead to the required progressive loss of neutron energy as required by the invention and would thus suffer the problems of low neutron capture efficiency. With reference to paragraph 61 of the published present application, in the case of 99Mo, which is plagued by a small capture cross section for thermal neutrons, the present invention as defined by claim 17 is able to exploit the large resonance cross-section of 99Mo to provide the required short lived radioisotope 99mTc.

Referring to *Venneri* (col. 3, lines 43-45), a molten salt medium is clearly distinguished from a lead-bismuth medium (*"Both thermal (based on molten salt) and fast spectrum (based on liquid lead-bismuth fuel) ..."*).

Consequently, it is submitted that the skilled person would not be motivated to use PbBi in the molten salt circulation loop. In *Bowman,* the primary loop serves a

different purpose (a spallation target) and thus has different requirements to the molten salt recirculation loop as outlined above.

For the reasons set forth above, it is respectfully submitted that Claim 17, and those claims depending therefrom, are patentable over *Bowman* and should be allowed.

II. The claims are not obvious over *Venneri.*

Claims 17 and 19 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Venneri et al. U.S. Patent No. 6,442,226. For the reasons set forth below, among others, it is respectfully submitted that Claims 17 and 19 are patentable over *Venneri.*

Venneri does not disclose using Pb-Bi in area 24 of Figure 1. Instead, it discloses molten salt. Referring to *Venneri* (col. 3, lines 43-45), molten salt is clearly distinguished from lead-bismuth. (*"Both thermal (based on molten salt) and fast spectrum (based on liquid lead-bismuth fuel) ..."*). It is clear that different effects are produced by molten salt and liquid lead-bismuth and thus the skilled person would not be taught to replace nor be motivated towards replacing molten salt by lead.

In fact, different embodiments are used for molten salt and for liquid lead. Figure 1 relates to the embodiment where molten salt is used, while Figure 9 relates to the embodiment where liquid lead is used. Thus, the skilled person would not be taught or motivated to simply replace area 24 of Figure 1 with lead. Instead, he would be taught or motivated towards using the embodiment of Figure 9. See col. 10, lines 52-55 ("FIG. 9 *is a schematic representation of.... the actinide and fission product transmutation apparatus, 32, for the liquid metal, fast neutron spectrum embodiment*). In this embodiment, the lead region is used as a target and does not contain any radioisotopes to be transmuted. Instead, any radioisotopes to be transmuted are found in a molten thorium breeding blanket.

Indeed, it is the surprising effect of allowing resonance neutron capture to be exploited which has led the inventor towards the invention as defined by claim 17 – the combination of a lead region devoid of radioisotopes and a lead region having radioisotope to be transmuted.

As explained above, both Lead and Bismuth have a small neutron capture cross section compared to their neutron elastic scattering cross section. In the case of Lead, the neutron scattering cross section is approximately 11 barns while the neutron absorption cross section is 0.0048 barns. In the case of Bismuth, the neutron scattering cross section is approximately 9 barns while the neutron absorption cross section is 0.034 barns. This enables a high proportion of elastic scattering.

Both Lead and Bismuth, or a mixture thereof, have a very small lethargy (fractional average energy loss at each neutron elastic collision) to the order of 9.54 10-3 (see page 3, line 30 to page 4, line 7 of the present application).

The effect of the above features of lead/bismuth is a progressive decrease in energy of the neutrons. In such a medium, the neutron energy is slightly reduced at each elastic scattering, thus scanning in very tiny energy steps through the resonance spectrum matching the largest value of the capture cross section of the relevant isotope of the sample. The progressive decrease in neutron energy thereby leads to enhanced neutron capture and thus the portion of radioisotope transmuted is maximized. This, in turn, enables the required amount of radioisotope to be produced with a relatively modest neutron generator.

In contrast, the molten salt region of *Venneri* does not exhibit these properties, which lead to the required progressive loss of neutron energy as required by the invention and would thus suffer the problems of low neutron capture efficiency. With reference to paragraph 61 of the published present application, in the case of 99Mo, which is plagued by a small capture cross section for thermal neutrons, the present invention as defined by claim 17 is able to exploit the large resonance cross-section of 99Mo to provide the required short lived radioisotope 99mTc.

For the reasons set forth above, it is respectfully submitted that Claim 17, and those claims depending therefrom, are patentable over *Venneri* and should be allowed.

III. **Claims 21-22 are not obvious over the prior art.**

Claims 21-22 stand rejected under 35 U.S.C. 103(a) as being unpatentable over *Bowman* as applied to claims 17, 19-21, 24, 25 and 28 above and further in view of *Borst* (3,197,375). Although the rejection indicates that Claim 6 is also rejected, Claim 6 was previously cancelled. For the reasons set forth above with respect to Claim 17, it is respectfully submitted that Claims 21 and 22 are both novel and non-obvious over the prior art.

IV. **Claims 31-32 are not obvious over the prior art.**

Claims 31-32 stand rejected under 35 U.S.C. 103(a) as being unpatentable over *Bowman* as applied to claims 17, 19-21, 24, 25 and 28 above and further in view of *Ruddock* (4,123,497). For the reasons set forth above with respect to Claim 17, it is respectfully submitted that Claims 31 and 32 are both novel and non-obvious over the prior art.

V. **Claim 17 is not obvious over the prior art.**

Claim 17 stands rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. 5,160,696 to *Bowman* in view of U.S. 6,442,226 to *Venneri*. Although the rejection indicates Claim 1 is also rejected, Claim 1 was previous cancelled. For the reasons set forth herewithin, it is respectfully submitted that combining the teaching of *Bowman* with *Venneri* will not lead to the invention of claim 17.

VI. TELEPHONIC INTERVIEW REQUEST

While the Applicant believes the present application is in condition for allowance, should the Examiner believe that the present response does not put the present application in condition for allowance, Applicant respectfully requests a telephonic interview to be scheduled to discuss the remaining issues.

Respectfully submitted,

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